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PRODUCTION LOCALIZATION FACTORS: AN INDUSTRIAL AND LITERATURE BASED REVIEW

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ABSTRACT

Decision are commonly based on the available or easily accessible information; this is also true for more complex assessments like production localization. Where to locate production is often a key strategic decisions that has great impact on a company's profitability for a long time; insufficient business intelligence may therefore have grave consequences. Six production localization factor studies have been assessed to see if they are focusing on the same issues and if there are any gaps. A new approach for structuring localization factors and the localization process is then presented and assessed with regards to some previously identified critical issues.

Keywords: production system, production localization, industrial study, localization factors.

1 INTRODUCTION

European manufacturing companies have successfully operated on an international marked for a long time. During the recent years the manufacturing industry has become even more global in its way of organizing manufacturing operations, both within their own manufacturing foot print and regarding suppliers and sub-suppliers. Functions are to a larger extend organized globally rather than based on region or country, and each function's localization is more and more based upon marked growth and customer demands rather than historical context. This is true not only for the larger corporations, also suppliers experience a stronger request from customers to join as new sites are established in new markets, or when the product portfolio is upgraded in current sites globally. Even though the debate on manufacturing outsourcing and off-shoring has become more balanced, the strategic process of determining the geographic site for a firm's production operations, i.e. production localization, is ever as important.

For years, researchers and practitioners have primarily detailed the aspects of production localization individually. Models and criteria have been tailored to specific problems, theories and decision objectives. Facilities location is a classic field of location theories, siting of one or more facilities in a way that optimizes certain objectives such as minimizing transportation costs, providing equitable service to customers, or minimizing delivery time (e.g. (Aikens 1985; Button 1993; Drezner 1995; Drezner and Hamacher 2001). Research on facilities localisation has been conducted from a multitude of perspectives since the pioneering work by (Ross 1896; Weber 1929; Hotelling 1929; Moses 1958), leading to an extensive knowledge base within the area. Research fields contributing to the area are models from operations research, public economics, operations strategy; these studies often focus on specific applications and cases. Still, the developed theoretical works on localisation tend to focus on a small number of decision factors (Pongpanich 1999).

Companies face this localisation challenge in different situations, such as enabling a growing production volume, entering a new market, introducing a new product or relocating a facility. The companies normally have at least one objective to consider in the location problem, in most cases to optimise cost and profit over time. However, during the recent decade a new set of aspects have gained momentum, influencing the strategy and design of the industrial network for tomorrow's successful industry. The localisation strategy has to function in a world of limited resources, change of values and a global economic view, and the decision of production location today relies on a more balanced set of decision variables than merely cost minimization.

The increasing complexity in decision variables call for a deeper understanding of the specific decision criteria behind production localisation decisions and production localisation strategy. The objective of this paper is to (1) review and structure a full set of decision factors in a production localization situation applicable for a larger global manufacturing company, and (2) discuss how the decision criteria can be included in the decision process to avoid insufficient or incorrect decision data.

2 METHOD AND MATERIAL

The literature base for the paper relies upon a broad search on literature on location decision criteria and processes applicable for production localisation applications. The empirical base for the paper relies on a long-term research project including five global larger manufacturing companies. Cases and established structures from the companies have been studied and related to a comprehensive set of literature in order to compile a full set of decision factors relevant for different production localization situations. The set of factors have in dialogue with the companies been structured in a functional/organizational hierarchical structure of decision factors. Based on the academic and industrial dialogues, the set of factors is included into a proposed decision process for production localization.

3 RESULT

3.1 Production localization categories in literature

To reach the right location decision, it is most important to select, analyse and evaluate the right location criteria (Yang and Lee 1997). From reviewing thirty-one central articles about location decision, in is clear that there is a huge number of location criteria having an influence on location decisions. Goetschalckx, Vidal, and Dogan (2002) classified location criteria from seven published strategic logistic models into four categories: *stochastic*, *taxation and cash flow*, *non-international* and *trade barriers*. Farahani, SteadieSeifi, and Asgari (2010) used a multi-criteria approach to approach localization problems and divided the criteria into six groups: *cost*, *environment risk*, *coverage*, *service level and effectiveness*, *profit*, and *other criteria*. Ferdows (1997) presented the drivers behind global spread of production and classified location factors into six categories: *government policies*, *market*, *skill and knowledge*, *risk*, *competition*, and *production and logistics cost*. Bergeron et al. (2005) classified factors in a site selection model into four groups: *geography and culture*, *environment*, *workforce*, and *cost and ROI*. Galan, Gonzalez-Benito, and Zuñiga-Vincente (2007) grouped location factors into five categories: *cost factors*, *market factors*, *infrastructure and technical factors*, *political and legal factors*, and *social and cultural factors*. Mentzer (2008) described seven key factors in effective facility location: *land*, *labour*, *capital*, *sources*, *production*, *markets*, and *logistics*.

Apart from the above six samples on classification, factors can be categorised into e.g. quantitative and qualitative categories. The quantitative is used for numerical values (for example cost, distance and revenue), while qualitative factors are difficult to measure in numbers such as policy, law and quality of work environment (Yang and Lee 1997); in addition, some of the qualitative factors are Boolean and only require a yes/no in an evaluation.

The above mentioned localization factor categories cover many of the key aspects in production localization. However, by mapping them in a 2x2 matrix, according to qualitative/ qualitative and if the categories address the development phase of the localization or the operational phase, it is apparent that the main focus lays on the easy to calculate factors associated with the production phase

(Figure 1). There are obvious risks associated with underplaying the impact from the qualitative factors and the costs during the development phase, e.g. (1) development of production facilities in new cultures and environments are complex project that often miss economical and time estimates; (2) the development itself may also have great impact on the ramp-up time and the final operations efficiency; (3) the quantitative factors during the operational phase often are beneficiary, while the qualitative ones often have a negative effect on the return on investment. In addition, many of the categories, specifically of the qualitative ones, have not been clearly identified as belonging to the development phase or the operational phase. There is an apparent risk that the location decision is based the operation stage, and that the calculations for the development are based on the direct costs for machines, utilities, and man-hours.

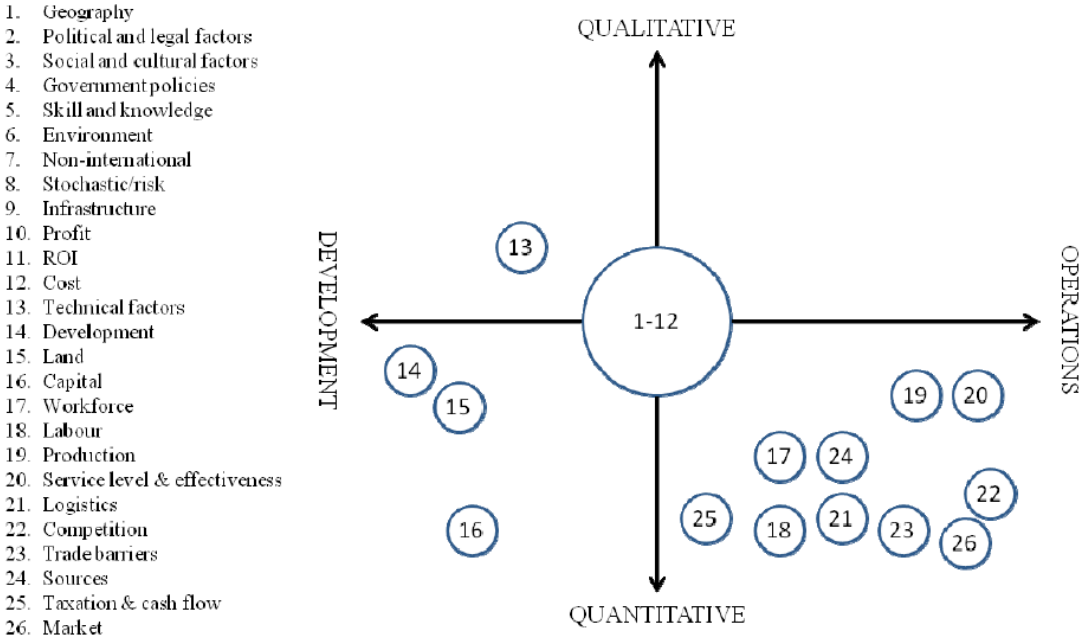

Figure 1: Localization categories in literature mapped according to development/organization and qualitative/quantitative

None of the categories discussed above specifically focus on the product; thereby, there is no clear connection between the product, the production processes and production system. By not highlighting the product, much of the complexity and many of the potential difficulties during both development and operation are hidden. A production location decision can be of different level of complexity, such as in scenarios 1-4 according to Figure 2 (analogous with Ansoff's classic growth matrix).

New product or technology	*Scenario 3* *Where to locate production for a new product introduction?*	*Scenario 4* *Where to locate production for a new product on a new market?*
Existing product	*Scenario 1* *Where to locate production for a volume increase or relocation?*	*Scenario 2* *Where to locate production for a marked expansion of current product?*
	Within current manufacturing footprint	Outside current manufacturing footprint

Figure 2: Four typical scenarios for production location decisions, increasing complexity (1 to 4).

A product's life cycle stages have been addressed as criteria to categorise factors that are in the early stage, companies often start producing products in the head quarter or research and development section. In contrast, at the end of product life, companies often locate the facility close to the market.

When assessing if a potential site is capable of meeting the production requirements, the company's previous experience is a key issue. An existing product or process is easier to start up a new plant for, and if a previous similar production localization has been done before, the requirements for local maturity is well known.

3.2 An holistic approach to production localization

Witnessed by the state of practice at the five companies in the study, and as previous authors also have emphasized, a location decision is a multistage decision with phases of strategic decisions as well as tactical decisions (e g Pongpanich (1999). The companies do not have a full set of decision factors at hand initially, instead there are well established components supporting the localization process, such as investment calculation standards, relocation checklists, sourcing principles etc. However, the full localization process including decision factors is vague to both structure and content.

Concluding the literature review and company study, a set of decision factors is presented based upon eight corporate functions:

- Sales & Marketing
- Production System Installation & Ramp-up
- Production System Operation
- Sourcing & Purchasing
- Legal & Finance
- Facilities & IT
- Human Resources
- R&D incl. Product Development

It is concluded from the academic/company dialogues that a natural ownership and industrial decomposition is enabled by structuring the factors by corporate functions. This categorization empowers the functional owners and engages them in setting objectives, constraints and following up results during the localization process. Moreover, it enables both different perspectives to be naturally included in the decision process, and a singular issue, e.g. product complexity, can more easily be included in different decisions.

In accordance with the critique of cited studies on localization categories, greater focus has been put on separating development, installation and ramp-up of the production system, and the operation of the system. In addition, the product is highlighted, which more clearly shows the link between product complexity, production complexity, and localization complexity. For each of the categories, the factors have been mapped according to qualitative/ qualitative and development/operations (Figure 3)

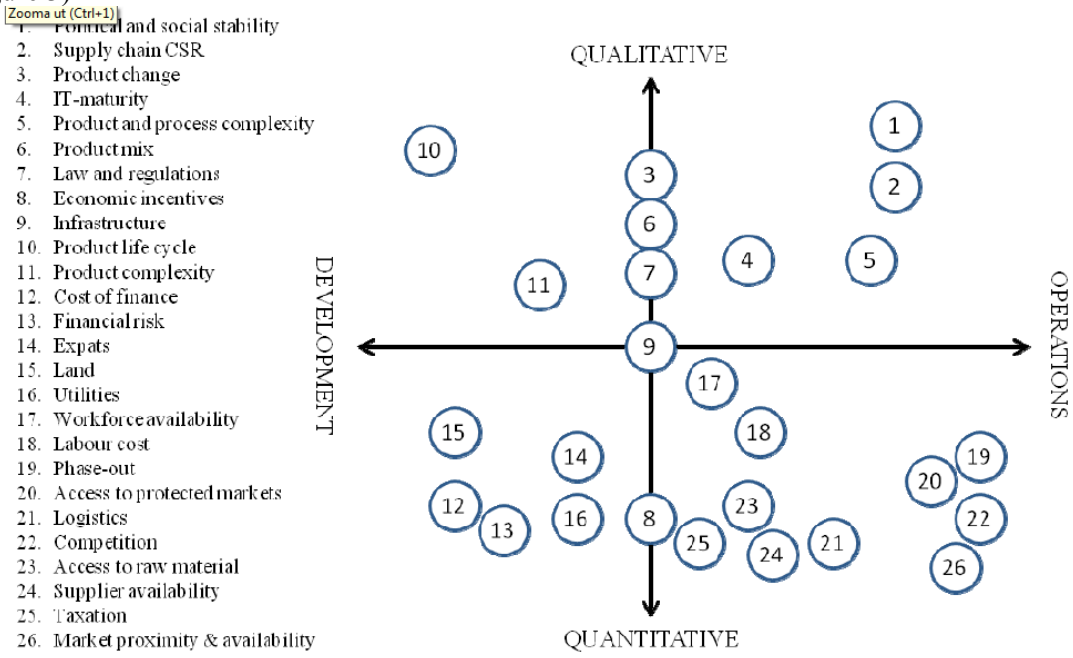

Figure 3: Holistic localization categories mapped according to development/organization and qualitative/quantitative

4 CONCLUSION

Location decision are commonly based on the available or easily accessible information. Business intelligence is often difficult to obtain or problematic to translate into economical terms; however, this is not an indication to that qualitative and more complex factors do not affect the profitability of the localization. A decision to place a production plant at a certain location has long term effects on a company's profitability; insufficient business intelligence may therefore have grave consequences.

By comparing six categories of location parameter categories with the results from case studies at five multinational Swedish manufacturing companies, we have identified three important gaps in the literature: (1) qualitative factors are not addressed to a sufficient extent, especially not issues related to the product; (2) the development phase, including initiation and ramp-up, is not a addressed to the same extent as the operational phase; and (3) location factors are addressed from only one perspective. These limitation do not allow for a more complex picture of the business intelligence to be developed.

We our cases we have found that location parameter categories should be based on company functions, and that the product and the development phase should be highlighted both for the categories and on the parameter level. Based on the studied industrial state of practice and existing body of research in production location factors, suggestions are made for future research within three areas: (1) process aligned models for production location decisions, (2) validated factor structures for production location decisions and (3) business case models for location decision.

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